The Arnold Engineering Development Center/ Advanced Missile Signature Center "Standard Archive Format"

Version 6.0

Revised: 2001 August 09

Philosophy

The Standard Archive Format **(SAF)** was created for flexible and extensible use in data archiving. Although the data may be ascii or one of several binary formats, the file header is plain ascii text and therefore human readable.

The "magic number" for identifying SAF files is the case-insensitive string: "HdSize ". Therefore, no naming conventions are required, and computer programs can easily identify the file format.

Both image and non-image data may be stored in the standard archive format. The type of data is identified by information stored in the header.

Header Format

The standard header is ASCII text consisting of tags, or field identifiers, followed by their associated values. The number of tags used in any particular header is variable dependent on the available, pertinent information. Additional header information can be added when required with an associated increase in header size. Tags and associated data fields may be listed in any order, **except** for the **HdSize** tag which is listed first and identifies the file as a SAF file.

Each tag consists of several characters, followed by a space. The tag names and values are case insensitive. Data display and analysis programs search the header for tags and treat the data appropriately.

General Requirements

Header Item	Advanced Missile Signature Center Requirement
HdSize	Exact number of header bytes, or the word "auto". If "auto" is used, then the last tag in the header must be "data" (with no value).
Line Termination	LF or CR/LF. If HdSize is not specified as "auto", then the byte count must include the line termination character(s).
Tag Names	All **standard tags are nine characters or less**. User defined tags may be from one to 29 characters.
Tag Value Fields	Variable length with ascii text. Leading and trailing spaces are ignored. Different parameters may have values which are text, integers, or floating point numbers.

Image Files

The header tag **KeyWrd** is used to identify image files as one of three types:

?? **IMG** - the data consists of irradiance or radiance values.

?? **CMAP** - the data consists of a color map and indices into the color map.

?? **PAV** - the data consists of ordered triplets: x, y, and value.

IMG Files

Rectangular image arrays have **IMG** as the **KeyWrd** value. Following the header is the two dimensional image data, consisting of an array of **XPixls** columns by **Ypixls** rows, stored in row major order (row one, followed by row two, followed by row three, etc.). If the file contains more than one field, the image is assumed to be interlaced. Following the image array is possibly a footer containing background information for Col or Row type background subtraction (**Note 1**). These data consist of an array of single precision floating point numbers, and this array can be present even if another background subtraction scheme is used (**Note 2**). The number of elements in this background array is **XPixls** for Col background subtraction and **YPixls** for Row background subtraction. The data units are specified by **StdUnt** (**Note 21**) for standard units, or by **DaUnit** for non-standard data units.

The **minimum header** for **IMG** image files includes:

```
HdSize auto
KeyWrd IMG
XPixls xxx
YPixls yyy
DaType type
BytOrd order
data
```

CMAP Files

Color mapped image files have **CMAP** as the **KeyWrd** value. Following the standard header are 768 bytes of the color map, with 256 bytes each for red, green, and blue, respectively. Following the color map are the image data. The value of each pixel in the image is a zero-referenced subscript to a color in the color map.

The **minimum header** for **CMAP** image files includes:

```
HdSize auto
KeyWrd CMAP
XPixls xxx
YPixls yyy
DaType type
BytOrd order
data
```

PAV Files

Position and Value image files have **PAV** as the **KeyWrd** value. The data consists of ordered triplets of position in x and y followed by the amplitude. The image reader code will interpolate the data to generate a rectangular array of the size given by the **XPixls** and **YPixls** tags. The image boundary points may be specified by using the **BndXX** tags to specify the clockwise sequence of boundary points. The origin is at the upper left hand corner of the image, with x increasing to the right and y increasing downward. If any boundary points are specified, then there must be at least three of them, in which case a triangular area would be generated.

The **minimum header** for **PAV** image files includes:

```
HdSize auto
KeyWrd PAV
XPixls xxx
YPixls yyy
DaType type
BytOrd order
NumDPs nnn
data
```

Non-Image Files

The header tag **KeyWrd** is used to identify plot files as one of three basic types:

?? **Multiple Parameters** - specified by the keyword **POD**. (Parameter Oriented Data)

?? **XY Pairs** - specified by one of the following keywords: **XYPT, XYFN, XYTM, XYDI or XYWL** (See Note 12 for a description of these keywords.)

?? **Y Values Only** - specified by one of the following keywords: **YPT, YFN, YTM, YDI, YWL or YWN** (See Note 12 for a description of these keywords.)

Multiple Parameters

This file type is for storing multiple parameters in the same file, such as time history data. Examples of such data are time, target position, velocity, and aspect angle, or time, motor chamber pressure, turbine speed, and case temperature, ...

It consists of the standard header, an optional line of parameter names, an optional line of parameter units, an optional line of parameter classifications, an optional line of parameter data types, followed by the data. The data may be arranged in columns (handy for human viewing), or in rows (quicker computer access). The **NumDPs** field may be set to **auto**, and the software will be responsible for computing the number of points. One note for this usage is when using the **multi** option, (See Note 25) the **NumIMGs** field should be set correctly. Otherwise, there will be no way to determine how many points constitute one set. Special tags are **required** to define the number of parameters in the file and the existence of the optional parameter names, units, security classifications, and data types. They are described below:

?? **NParam** - The tag **NParam** will indicate the number of parameters.

?? **Parameter Names** - If the tag **PNSize** has a value greater than 0, then the user **must** provide a single line of text giving the parameter names of the data. Spaces, tabs, commas, colons, semicolons, and vertical bars may be used as delimiters between parameter names. All parameters will have **names not exceeding 127 characters**. Any parameter name which includes a delimiter must be enclosed in double quotes.

?? **Parameter Units** - If the tag **PUSize** has a value greater than 0, then the user **must** provide a single line of text giving the parameter units of the data. The same delimiters allowed for parameter names apply. All parameters will have units **not exceeding 63 characters**. Any parameter unit which includes a delimiter must be enclosed in double quotes. Use a pair of double quotes ("") as a space holder for a parameter which has no units.

?? **Parameter Classification** - If the tag **PCSize** has a value greater than 0, then the user **must** provide a single line of text giving the security classification of each parameter.

The **Class** tag in the header reflects the classification of the **entire** file. If separate classifications for each parameter are not given, then the value of the **Class** tag is assumed for all. The **maximum length of a classification string is 127 characters**. Any classification which includes a delimiter must be enclosed in double quotes.

?? **Parameter Data Type** - If the tag **PTSize** has a value greater than 0, then the user **must** provide a single line of text giving the data type of each parameter, i.e. ascii, float, int. If separate data types for each parameter are not given, then **float** is assumed for all.

The order for parameter information is names, units, classifications and types (assuming all are included). For example, if PnSize, PuSize and PtSize are all set, there would be a line for names followed by a line for units followed by a line for types. The remainder of the pod file contains the parameter values. The data type of these values is defined by the header tag **DaType**. If **DaType** is **ASCII**, you can further define each individual parameter as having separate data types. The choices include **float, int, and ascii**. If **DaType** is **ASCII**, then a space, comma, tab, colon, semicolon, or vertical bar may be used to separate parameter values. Non-numeric data may only be stored in ASCII files. Quotes may be used to group sequences of characters. The **maximum length of a data value is 256 characters**.

```
Example:  HdSize Auto
          DaType ASCII
          Keywrd POD
          Class Unclassified
          PcSize 0
          PuSize 1
          PnSize 1
          PtSize 1
          Nparam 6
          NumDPs 5
          Data
          TIME ALTITUDE  VELOCITY  "ASPECT ANGLE"  Filter  Camera
          sec. meters    meters/sec   degrees        ""      ""
          float float    float        float          int   ascii
          0.0    0.0       0.0          90.          1     "NIKA 2"
          1.0    10.0      1.0          89.          1     "NIKA 2"
          2.0    20.0      2.0          88.          1     "NIKA 2"
          3.0    30.0      3.0          87.          2      FTS
          4.0    40.0      4.0          86.          2      FTS
```

NOTE - PTSize and the row of data types are only required if using non-numeric values for a parameter.

XY Pairs

Ordered pair data (Radiance vs wavelength, pressure vs time, In-band radiance vs axial distance, etc.) are preceded by the standard header. The two column ordered array is then listed in an xy format. One or more blank spaces separate the values in each row. Parameter names are specified by **XParam** and **YParam**. Data units for x and y are specified by **XDaUnt** and **DaUnit**. As with the multiple parameter plot files, **NumDPs** is a required tag, indicating the number of data points (values) per parameter.

The **minimum header** for **XY** data files includes:

```
HdSize auto
KeyWrd XYPT          (or one of the others listed above)
NumDPs number
DaType type
BytOrd order
data
```

Y Values Only

An alternate form of an xy data file can be used (if desired) when the x values are equally spaced in time, wavelength, position, etc. For this form, only the y values are stored, with the x values calculated using additional parameter tags (**XYFRST**, **XYLAST**, **NumDPs**).

The **minimum header** for **YPT** data files includes:

```
HdSize auto
KeyWrd YPT
XYFrst firstx
XYLast lastx
NumDPs number
DaType type
BytOrd order
data
```

Description of Tags

The following tables define the valid header tags. Several tags are mandatory (for AMSC display tools), depending upon the type of data in the file. Tags should be selected which provide the user with sufficient information to read, understand, and evaluate the data file.

Tables 1 - 13: Generic Tags (for including information common to all instrument types)

Table 1: File/Format Information

Tag Name	Data Type	Units	Description
AQMODE	Text	-	Acquisition Mode (See Note 10 for valid codes)
BYTORD	Text	-	Byte Order (See Note 3)
DATA	None	-	Delimiter to signal end of header for **HdSize AUTO**
DATYPE	Text	-	Data Type (See Note 4)
HDSIZE	integer or Text	-	Header Size (in bytes, or it may be AUTO) **AUTO is preferred.**
HDVERS	Text	-	Header Version (= 5.0)
KEYWRD	Text	-	File Type Keyword (See Note 12)
MULTI	Text	-	Multiple images or parameter groups per file (See Note 25)

Tag Name	Data Type	Units	Description
NUMIMGS	integer	-	Number of images or parameter groups in a multi-image file
SDLEVL	Text	-	BMDO Data Level (See Note 15)

Table 2: Classification Information

Tag Name	Data Type	Units	Description
CLASS	Text	-	Classification. (See Note 30)
CLASS_BY	Text	-	Official 'Classified By' statement (from Security)
DCLASS_ON	Text	-	Official 'Declassify On' statement (from Security)
DDOFF	Text	-	Data Distribution Office
DERIVED_F	Text	-	Identifies where the classification originated - IF MULTIPLE GUIDES, SEPARATE BY '::'
DISTAT	Text	-	Distribution Statement (See Note 29)

Table 3: Mission/Experiment Information

Tag Name	Data Type	Units	Description
EVENTTYPE	Text	-	Type of Event (Simulation, Field, Lab, etc)
EXPID	Text	-	AMSC Experiment ID#
MISS	Text	-	Official Mission Name (found in MRD or TEAS)
MDATE	MM/DD/YYYY	-	Mission Local Date
PROGNAME	Text	-	Official Program Name associated with this Mission
SPONSOR	Text	-	Official Mission sponsor including office and office symbols (Who paid?)
TESTNO	Text	-	Test Number

TEST_TYPE	Text	-	Test Description (Static, Free Flight, Wind Tunnel, ...)
TRLNUM	Text	-	Trial Number

Table 4: Time Information

Tag Name	Data Type	Units	Description
CIDAY	integer	day	Collection IRIG Day
CIHOUR	integer	hour	Collection IRIG Hour
CIMIN	integer	min	Collection IRIG Minute
CISEC	float	sec	Collection IRIG Seconds
CIYEAR	Integer		Collection IRIG Year
CIZONE	Text		Defines the time zone of the Collection IRIG times. Either UTC or LOCAL (default is UTC)
SECCOL	float	-	Number of Seconds Collected
TALO	float	sec	Time After Lift-Off
TZDAY	integer	-	T-Zero Day (IRIG)
TZHOUR	integer	-	T-Zero Hour (IRIG)
TZMIN	integer	-	T-Zero Minute (IRIG)
TZSEC	float	-	T-Zero Seconds (IRIG)
TZYEAR	integer		T-Zero Year (IRIG)
TZZONE	Text		Defines the time zone of the T-Zero times. Either UTC or LOCAL (default is UTC).
UTCDIF	float	hour	Difference in hours between UTC (GMT) time and LOCAL time zone **(# of hours to ADD to UTC to get Local, may be negative**)

Table 5: EUD Information

Tag Name	Data Type	Units	Description
BGTYPE	Text	-	Background Type (See Note 1)

Tag Name	Data Type	Units	Description
BGFILE	Text	-	Background File (See Notes 2 and 6)
BGVALU	float	-	Background Value (Average or Fixed) (See Note 2)
DAUNIT	Text	-	Data Units (See Note 20)
EURAW	Text	-	Processed Level of the Data EU/RAW/Flat-fielded (FF)
LINLOG	Text	-	Processing Type (LIN/LOG/ASG) (See Notes 2,5,16)
LOGASL	float	-	Log Amp Slope (See Notes 5,16)
LOGOFF	float	-	Log Offset (See Notes 5,16)
OFFCOR	float	-	Offset Correction (See Note 2)
SCLFAC	float	-	Calibration or Scale Factor (See Note 2)
STDUNT	integer	-	Standard Data Units Index (See Note 20)
TPFACT	float	-	Transmission Path Factor (Note 2)

Table 6: Sensor Information

Tag Name	Data Type	Units	Description
PPCNAM	Text	-	Sensor Platform Name (HALO)
PPCTYP	Text	-	Sensor Platform Type (Ground, Aircraft, Space, ...)
SENSOR	Text	-	Sensor Name
SNSALT	float	meters	Sensor Altitude
SNSLAT	float	deg	Sensor Latitude
SNSLONG	float	deg	Sensor Longitude
SNSMATL	Text	-	Sensor Detector Material (Galium, Arsenide, ...)
SNSTYP	Text	-	Sensor Type (Imager, Spectrometer, Radiometer, ...)
SNSVEL	float	m/sec	Sensor Velocity

Table 7: Target Information

Tag Name	Data Type	Units	Description
LODANG	float	-	Observer Line-of-Sight Angle wrt True North (CW is +)
MACH	float	-	Mach Number
PAYLDTYP	Text	-	Payload Type (RV, PENAID, ...)
TAOA	float	deg	Target Angle of Attack
TARGET	Text	-	Official name of overall target object/missile
TRGALT	float	meters	Target Altitude
TRG_BGRND	Text	-	Background Classifier (Hard Earth, Sky, Space,...)
TRGFUEL	Text	-	Target Fuel (Cryogenic, Amine, Kerosene, Aluminized, ...)
TRGHDG	float	-	Target Heading with respect to True North (CW is pos)
TRGLAT	float	deg	Target Latitude
TRGLONG	float	deg	Target Longitude
TRGPAYLD	Text	-	Target Payload
TRGTYP	Text	-	Target Type (Missile, Aircraft, Lightning Strike, ...)
TRGVEL	float	m/sec	Target Velocity

Table 8: Instrument Information

Tag Name	Data Type	Units	Description
ASPANG	float	deg	Aspect Angle
AZIMUTH	float	deg	Azimuth (See Note 32)

Tag Name	Data Type	Units	Description
DIAFOV	float	deg	Circular Field Of View
ELANG	float	deg	Elevation Angle (See Note 31)
FILTER	Text	-	Filter Name
FILTNO	integer	-	Filter Number
FOVAXL	float	meters	Chamber Test FOV Axial Location (See Note 7)
FOVRDL	float	meters	Chamber Test FOV Radial Location (See Note 8)
FOVType	text		Describes the Field of View Shape, valid values are CIRCULAR, ELLIPSOIDAL, and RECTANGULAR.
HORFOV	float	deg	Horizontal Field Of View
IHFOV	float	microradians	Horizontal Field Of View of a Single Pixel
ITIME	float	sec	Integration Time
IVFOV	float	microradians	Vertical Field Of View of a Single Pixel
NEQ	float	-	Noise Equivalent Quantity (See Note 9)
NODENO	Text	-	Node Number
ROLANG	float	deg	Roll Angle
SBPLO	float	microns	System Bandpass, Lower Wavelength
SBPUP	float	microns	System Bandpass, Upper Wavelength
SLTRNG	float	meters	Slant Range
THRUST	float	Klbf	Nominal Thrust
VRTFOV	float	deg	Vertical Field Of View

Table 9: Referenced Files

Tag Name	Data Type	Units	Description
BPFILE	Text	-	Bad Pixel File (See Note 6)
CAFILE	Text	-	Calibration File (See Notes 2 and 6)

Tag Name	Data Type	Units	Description
CSFILE	Text	-	Calibration Source File (See Note 6)
INCLUDE	Text	-	File Name of Additional Header Information (See Note 26)
INCLUDE01	Text	-	As above with numbers from 01 through 99 (See Note 26)
INFILE	Text	-	File Name of Additional Reference Information (See Note 27)
RDFILE	Text	-	Raw Data File (See Note 6)
REFILE	Text	-	Reference POD file (See Note 25)
SLFILE	Text	-	Spectral Lamp File

Table 10: Impact and Launch Site Information

Tag Name	Data Type	Units	Description
IMP_ALT	float	m	Altitude of the impact point
IMP_LAT	float	deg	Latitude of the impact point
IMP_LONG	float	deg	Longitude of the impact point
LCH_ALT	float	m	Altitude of the launch site
LCH_LAT	float	deg	Latitude of the launch site
LCH_LONG	float	deg	Longitude of the launch site

Table 11: Commentary Information

Tag Name	Data Type	Units	Description
COMENT	Text	-	Comment Line (Repeated as Required) This tag is no longer recommended. Instead, you are recommended to use Note01, Note02, ...

NOTE01	Text	-	Numbered Notes, valid from Note01 through Note99
WARN01	Text	-	Warning to the user, valid from 01 thru 99

Table 12: Uncertainty Information

Tag Name	Data Type	Units	Description
MEASUN	float	%	Measurement Uncertainty-Nominal
XUNCLO	float	-	Independent Parameter Uncertainty - Lower Limit
XUNCUN	float	-	Independent Parameter Uncertainty Units
XUNCUP	float	-	Independent Parameter Uncertainty - Upper Limit
YUNCLO	float	-	Dependent Parameter Uncertainty - Lower Limit
YUNCUN	float	-	Dependent Parameter Uncertainty Units
YUNCUP	float	-	Dependent Parameter Uncertainty - Upper Limit

Table 13: Miscellaneous Tags

Tag Name	Data Type	Units	Description
NCOADS	integer	-	Number of Coads
REGIME	Text	-	Flight Regime (Boost, Midcourse, Terminal)
STAGE	integer	-	Launch Vehicle Stage Number (1, 2, 3, ...)
STAGENAME	Text	-	Launch Vehicle Stage Name
USRCON	Text	-	User-Specified Parameters Header Filename (See Note 17)

Table 14: Imager Tags - commonly used with image data

Tag Name	Data Type	Units	Description
APSIZE	float	mm	Aperture Diameter
BGBLRX	integer	-	Lower Right X for Background Box (Note 2)

Tag Name	Data Type	Units	Description
BGBLRY	integer	-	Lower Right Y for Background Box (Note 2)
BGBULX	integer	-	Upper Left X for Background Box (Note 2)
BGBULY	integer	-	Upper Left Y for Background Box (Note 2)
CGAIN	float	-	Camera Gain
COMPRS	Text	-	Compression Type (Note 24)
DGFLD	float	-	Digitizer Gamma setting (non-linear adj.) (Note 14)
DITYPE	Text	-	Digitizer Type (Note 14)
DSGAIN	float	-	Digitizer System Gain
DSOFF	float	-	Digitizer System Offset
EMISS	float	-	Emissivity
FILFAC	float	-	Fill Factor for FPA Imagers in Percent (0 - 100)
FLDFRM	integer	-	Fields per Frame
FLORFR	text	-	*Field* or *Frame* Data in this File
FRATE	float	-	Frame Rate (frames/second)
IMDISP	text	-	Pre-digitized image display format (Note 14)
IMQUAL	text	-	Image Quality (Note 11)
IMSIG	Text	-	Pre-digitized image signal type (Note 14)
INTRLC	Text	-	Frame Data Are Interlaced in the File
MAX	float	-	Maximum image value
MIN	float	-	Minimum image value
Scal01	float	-	Camera Gain Scale Factor. Can have Scal01, Scal02, ..., Scal99.
SPECFN	Text	-	Special Function to apply to the image (Note 22)
XMAG	float	-	X Compress or Enlarge Factor from Original
XPIXLS	integer	-	Digitized Data Image Width (pixels)

Tag Name	Data Type	Units	Description
XPXWID	float	-	X (horizontal) Pixel Width (meters) (Note 28)
XUNITS	Text	-	X Dimension Units (Note 28)
YMAG	float	-	Y Compress or Enlarge Factor from Original
YPIXLS	integer	-	Digitized Data Image Height (pixels)
YPXWID	float	-	Y (vertical) Pixel Width (meters) (Note 28)
YUNITS	Text	-	Y Dimension Units (Note 28)

Table 15: Data Tags - typically used for spectra or time varying data

Tag Name	Data Type	Units	Description
CALC01	Text	-	Calculated Parameter, valid from 01 thru 99 (See Note 23)
FRERSP	float	Hz	System Electrical Frequency Response
NPARAM	integer	-	Number of Parameters in File
NUMDPS	integer	-	Number of Data Points in File
PCSIZE	integer	-	Flag that indicates if parameter classifications are given in the data file (for value > 0) (POD files only)
PNSIZE	integer	-	Flag that indicates if parameter names are given in the data file (for value > 0) (POD files only).
PODORD	Text	-	Data Ordering in POD Files (See Note 19)
PTSIZE	integer	-	Flag that indicates if parameter types are given in the data file (for value > 0). (POD files only)
PUSIZE	integer	-	Flag that indicates if parameter units are given in the data file (for value > 0). (POD files only)
SAMPRA	float	Hz	Sample Rate
XDAUNT	Text	-	X-Axis Data Units
XFNAME	Text	-	X-Axis File Name (a 1 parameter POD file, for YPT)

Tag Name	Data Type	Units	Description
XPARAM	Text	-	X-Axis Parameter name
XSCFAC	float	-	X-Axis Scale Factor (applied to XFName values)
XYFRST	float	-	XY First Value (first X value in YPT file)
XYLAST	float	-	XY Last Value (last X value in YPT file)
YPARAM	Text	-	Y-Axis Parameter name

Table 16: Active Source Tags - describes both the active source and detector used in acquiring data.

Tag Name	Data Type	Units	Description
SRCNAM	Text	-	Active Source AMSC Component Name
SRCWAV	float	-	Active Source Wavelength or Frequency (Note 13)
SRCWID	float	-	Active Source Scan Width (GHz)
SRCWUN	Text	-	Source Wavelength or Frequency Units (Note 13)
SRCRAT	float	-	Active Source Scan Rate (Hz)

Table 17: Atmospheric Tags – describes atmospheric conditions at the time of data acquisition.

Tag Name	Data Type	Units	Description
AIRTEMP	float	Kelvin	Temperature of the atmosphere.
ABSHUM	Float	g/cubic meter	The mass of water vapor per volume.
AIRPRESS	float	millibar	Pressure of the atmosphere.
DEWPOINT	float	Kelvin	Temperature at which the air becomes saturated with water vapor. It is a function of the partial pressure of water vapor.
OZONE	float	parts/million	Ozone concentration as measured by ozone sensor.
RELHUM	float	percentage	Humidity of the atmosphere. It is the percent of water

Tag Name	Data Type	Units	Description
			the gas mixture (air) is capable of holding at the specified temperature.
METLat	float	degrees	Latitude of MET station
METLong	float	degrees	Longitude of MET station
METAlt	float	m	Altitude of MET station
VIS	float	km	The meteorological range as defined in the government standard atmospheric code MODTRAN using the following form of the Koschmieder formula: VIS = 3.912/B, where B is the extinction coefficient evaluated at 0.55 micrometers. If, as is commonly true, only an observer visibility (VisObs) is available, the meterological range can be estimated for MODTRAN using the approximation VIS = 1.3 * VisObs, with an error around 25% in the approximation.
VisObs	float	km	The maximum distance at which prominent objects, such as mountains, buildings, or towers, etc., can be seen and identified with the unaided eye in any particular circumstances. Also, the slant visibility from airplane to ground. It is related to the meteorological range, VIS, used in the government standard atmospheric code MODTRAN by the approximation VIS = 1.3 * VisObs.

Table 18: MSX Tags- specific to MSX data

Tag Name	Data Type	Units	Description
FOV_FLAG	Text	-	Indicates view for central pixel of each image. Valid values are “CEL” for Celestial Viewing, “EL” for Earth Limb, or “SE” for Solid Earth.
LOSDec	float	degrees	line-of-sight declination, 0 to –90 deg southward, 0 to +90 deg northward.
LOSRA	float	degrees	line-of-sight right ascension, 0 to 360 deg, positive eastward.

Tag Name	Data Type	Units	Description
LOSRng	float	km	line-of-sight distance from MSX to pierce point. Nonzero only for a pierce point, zero for Earth Limb or Celestial observation.
MSXECIx	float	km	MSX position rectilinear x coordinate in earth-centered, inertial coordinates.
MSXECIy	float	km	MSX position rectilinear y coordinate in earth-centered, inertial coordinates.
MSXECIz	float	km	MSX position rectilinear z coordinate in earth-centered, inertial coordinates.
MSXGcLat	float	degrees	MSX position geocentric latitude, 0 to -90 deg south, 0 to +90 deg north. Referenced to an Earth-Centered, Earth-Fixed (ECEF) coordinate system.
MSXGcLong	float	degrees	MSX position geocentric longitude, 0 to 360 deg, positive eastward. Referenced to an ECEF coordinate system.
MSXGdAlt	float	km	MSX position geodetic altitude. Referenced to an ECEF coordinate system.
MSXGdLat	float	degrees	MSX position geodetic latitude, 0 to -90 deg south, 0 to +90 deg north. Referenced to an ECEF coordinate system.
MSXLunAz	float	degrees	MSX lunar azimuth angle.
MSXLunZen	float	degrees	MSX lunar zenith angle.
MSXSolAz	float	degrees	MSX solar azimuth angle.
MSXSolZen	float	degrees	MSX solar zenith angle.
PPGcLat	float	degrees	pierce point position geocentric latitude, 0 to -90 deg south, 0 to +90 deg north. Referenced to an ECEF coordinate system.
PPGcLong	float	degrees	pierce point position geocentric longitude, 0 to 360 deg, positive eastward. referenced to an ECEF coordinate system.
PPGdAlt	float	km	pierce point position geodetic altitude. Referenced to an ECEF coordinate system

Tag Name	Data Type	Units	Description
PPGdLat	float	degrees	pierce point position geodetic latitude, 0 to -90 deg south, 0 to +90 deg north. Referenced to an ECEF coordinate system.
PPSolAz	float	degrees	pierce point solar azimuth angle.
PPSolZen	float	degrees	pierce point solar zenith angle.
PPLunAz	float	degrees	pierce point lunar azimuth angle.
PPLunZen	float	degrees	pierce point lunar zenith angle.
QUATERN_s	float	-	Quaternion scalar.
QUATERN_X	float	-	Quaternion vector X component.
QUATERN_Y	float	-	Quaternion vector Y component.
QUATERN_Z	float	-	Quaternion vector Z component.

Notes

1. Background Type Code (BgType)

```
Col   Column Average (each column has an average background value)
Row   Row Average (each row has an average background value)
Avg   Floating Box Average
File  File Subtraction
Fix   Fixed Value
None  Assume Zero Background
```

2. Linear Data EUD Calculation

This information was originally provided for image data sets, but can be adapted as required for other data set types. Instrument specific variations in this equation should be documented with the data set in an ASCII file.

The linear data mode is indicated by LIN in the LinLog field. The equation for converting the pixel values to engineering units is

```
EUD = (PixelValue - Background)*SclFac*TPFact+OffCor
```

The units of the resulting value are defined in DaUnit. The individual pixel values and the background value(s) are required to have the same units (i.e., counts or volts). SclFac is

responsivity factor for the instrument which obtained the data, and is defined in radiance per detector output units (i.e., W/sr- cm^2-count or W/sr-cm^2-volt). Scale Factors (SclFac) that vary on a pixel by pixel basis are stored in the file identified in Cafile. If neither CaFile or SclFac are specified, SclFac defaults to 1.0 for all pixels.

TPFact is a dimensionless correction factor to adjust for transmission path effects, and defaults to 1.0 if not present. OffCor is an optional data correction offset factor (with a default of 0.0) and has the units defined in DaUnit. If the background type (BgType) is set to None or not present, the background defaults to 0.

For Avg and Fix backgrounds, the background value, which is the same for all pixels, is defined in BgValu. In addition, for the Avg type of background, the corners of the box used to compute the background are given in (BGBULX, BGBULY), (BGBURX, BGBURY), (BGBLLX, BGBLLY), and (BGBLRX, BGBLRY).

If the background type is Row, the footer contains an array of floating point number of dimension Ypixls. Then for all pixels in row 1 of the image, the first element of the footer array is used as the background; for all pixels in row 2 of the image, the second element of the footer array is used as the background, etc.

If the background type is Col, the footer contains an array of floating point number of dimension XPixls. Then, for all pixels in column 1 of the image, the first element of the footer array is used as the background; for all pixels in column 2 of the image, the second element of the footer array is used as the background, etc.

If the background type is File, the BgFile field must contain a name for a background image file of the same format as all standard images. For file background subtraction, the background value for any pixel in the image file is the corresponding pixel in the background image.

3. Byte Order Codes (BytOrd)

```
LH   Low order byte first (Typical DOS application)
HL   High order byte first
VX   VAX byte order
```

4. Data Type Codes (DaType)

```
ASCII          ASCII
Int8      1-byte unsigned integer (0 - 255)
Int16     2-byte integer
UInt16    2-byte unsigned integer (0 - 65,535)
Int32     4-byte integer
UInt32    4-byte unsigned integer (0 - 4,294,967,295)
Int64     8-byte integer
Flt32     Single precision floating point
Flt64     Double precision floating point
RGB24     24-bit color image (3 bytes per pixel, RGB)
```

5. Log Data EUD Calculation (LogASL, LogOff)

This information was originally provided for image data sets, but can be adapted as required for

other data set types. Instrument specific variations in this equation should be documented with the data set in an ASCII file.

This mode of operation is indicated by the presence of LOG in the LinLog field. The equation for converting log camera data to engineering units is

```
EUD = (SclFac*TPFact)*(10^(LogASl*(PixelValue-LogOff)) -
      10^(LogASl*(Background-LogOff)))
```

where SclFac, TPFact, OffCor, and DaUnit are defined the same as for linear data and LogOff is a tape recorder offset adjustment which defaults to 0. If the background type is set to None or not present, the second term in the equation (enclosed in braces []) defaults to 0.

6. Ancillary Files

Any files named in the standard header are themselves required to have a standard header.

7. Captive test FOV Axial Location (FOVAxl)

This parameter is defined as the distance from the nozzle exit to the center of the FOV (center pixel in the digitized image) parallel to the direction of flow and normal to the nozzle exit plane, with positive values in the direction of flow. The axial location is typically specified only for near-field test chamber or static test measurements.

For target aspect angles of 0 deg (nose-on) or 180 deg (tail-on), this parameter represents the horizontal distance to the target center.

8. Captive Test FOV Radial Location (FOVRdl)

This parameter is defined as the distance from the plume centerline to the center of the FOV (center pixel in the digitized image) in a line normal to the direction of flow and parallel with the nozzle exit plane, with positive values being up and to the right in the digitized image. The radial location is typically specified only for near-field test chamber or static test measurements. For target aspect angles of 0 deg (nose-on) or 180 deg (tail-on), this parameter represents the horizontal distance to the target center.

9. Noise Equivalent Quantity (NEQ)

This parameter has the units defined in DaUnits. The intent is to identify the rms noise level in the data. Nominal values should be specified and separate files archived as required for spatially or temporally dependent noise equivalent parameters.

10. Acquisition Mode Codes (AqMode)

```
FM   FM Tape
LV   Live (Real time digitization)
OP   Video Optical Disk
UM   Umatic Tape
VR   VCR
SV   Super VHS
D2   D2 Digital Video Tape
```

11. Quality Codes (ImQual)

```
     OK   Preferred Image, scan or data point
     NO   Non-preferred Image, scan or data point
```

12. SAF Keyword Codes (KeyWrd)

Data Format	KeyWrd	Description
Image	IMG	2-D array of values (the default)
	CMAP	2-D array of color map indices
	PAV	Position and value triplets
Parameter Oriented Data	POD	Multiple parameters
xy pairs	XYPT	(x,y) pairs, y vs. points
	XYFN	(x,y) pairs, y vs. file number
	XYTM	(x,y) pairs, vs. time
	XYDI	(x,y) pairs, y vs. distance (in meters)
	XYWL	(x,y) pairs, y vs. wavelength
y values only	YPT	y vs. points
	YFN	y vs. file number
	YTM	y vs. time
	YDI	y vs. distance (in meters)
	YWL	y vs. wavelength
	YWN	y vs. wavenumber

13. Active Source Wavelength and Units (SrcWav, SrcWUn)

Not a required parameter for lamps or blackbodies. Standard units are micron, GHz, or cm^{-1}.

14. Digitizer Settings

Digitizer system settings are required to maintain traceability and repeatability. Pre-digitized image information to be listed includes the display type and the signal type. The Gamma setting is required for Quantex-digitized imagery. Options are listed in the table below.

PARAMETER	DIGITIZER TYPE	IMAGE SIGNAL	DISPLAY TYPE
Tag	DiType	ImSig	ImDisp
Possible Values	Quantex	RGB	Color
	Matrox	NTSC	
	RCI_RTD_8*	PAL	
	RCI_RTD_10*	SECAM	
	YUV_RTD_8**		

```
     *RCI Real-Time Disk, 8-bit or 10-bit Resolution
     **RCI YUV File Format, 8-bit Resolution
```

15. BMDO Data Levels (SDLevl)

?? **Level 0**

Uncalibrated telemetry or other uncalibrated test data as recorded directly from the measuring instrument(s). This level represents data recorded on analog or digital media and consists of electrical readings in either discrete or analog form, but totally unprocessed.

?? **Level 1**

Measurement data which have been converted to digital form either directly from the recording instrument or by digitizing analog media. These data will be in raw (uncalibrated) counts and will represent the data as originally recorded, only in digital form. Level 1 data are organized in proper time order, separated by instrument, with a complete copy of housekeeping information and geometric positioning information as recorded in the telemetry. Data is placed into a raw database.

?? **Level 2**

Data which have been converted from uncalibrated counts or instrument readings to scientific or engineering physical units. These units are derived from the application of calibration algorithms to the uncalibrated data. Level 2 data have been checked for data quality and correctness, but not for information content. The final Level 2 data are stored as verified and validated. Data is assembled into a reduced database.

?? **Level 3**

Information resulting from the initial analysis of the data intended to correlate the various measurements with pertinent physical parameters. Slant range has been incorporated at this level.

?? **Level 4**

Data used for model evaluation, answering critical questions and issues, system feasibility assessments, and decision making.

16. ASG IRIS DATA EUD CALCULATION (from Flat-Fielded Data)

```
EU   =    Exp[{ln(x-bg)-a} / b]
a    =    LogASl in header
b    =    LogOff in header
bg   =    Background Value
x    =    Pixel Value
```

The (x-bg) factor is set to 1.0 if the calculation results in a value less than or equal to zero.

17. User Controlled Tags (USRCON)

Certain experiments may have specific and exceptional information to be included in the header. For such programs, a second header file is created in the same format as the standard file which includes tags and associated information. This file is named as specified by the parameter USRCON in the standard header. It is the responsibility of the archivist to provide sufficient documentation describing the user-specified tags and definitions.

18. Stage Number (Stage)

This tag is used to indicate which stage is thrusting during powered flight. For most data sets and targets, the use of this tag will be straight forward. Nomenclature or conventions are not specified by this document for instances when the target coasts between stages, there are combination burns of different stages (e.g. Titan 34D), or when prominent interstage events occur. This tag is used by some AMSC Software tools to graphically indicate the approximate operating times or regions for the various stages.

19. Data Ordering in POD Files (PodOrd)

This tag is used to indicate the storage order in POD files. The default value is COL, which is most suitable for ASCII files. In this case the data for each parameter is in a column, with each row having one value for each parameter. For binary files, the alternate value Row is more suitable. In this case all the data for each parameter occupies one row in the file. For binary files this means that all the data for each parameter is contiguous, allowing faster access.

20. Standard Data Units (StdUnt)

Standard data units are specified using this tag. For human readability of the header information, the data units may be placed in the header using the DaUnit tag also. The StdUnt tag will take precedence over the DaUnit tag.

Index	Units	Standard Abbreviation
0	Nonstandard, use DaUnit	
1	Counts	cnt
2	Volts	V
3	Amperes	A
4	Watts	W
5	Fahrenheit Temperature	deg F
6	Celsius Temperature	deg C
7	Rankine Temperature	deg R
8	Kelvin Temperature	K
9	Meters	m
10	Centimeters	cm
11	Kilometers	km
12	Micrometers	um
13	Seconds	sec
14	Steradians	sr
15	In-Band Radiant Intensity	W/sr
16	In-Band Irradiance	W/cm^2
17	In-Band Radiance	W/(sr cm^2)
18	Spectral Radiant Intensity	W/(sr um)
19	Spectral Irradiance	W/(cm^2 um)
20	Spectral Radiance	W/(sr cm^2 um)
21	Station Radiance	W/(sr cm)
22	Image Pixels	pixels
23	User Defined	user defined
24	Hours	hour
25	Minutes	min
26	Milliseconds	ms
27	Nanoseconds	ns
28	Percent	%
29	Hertz	Hz
30	Microradians	microradians
31	Bytes	bytes

32	Month/Day/Year	MM/DD/YYYY
33	Meters per Second	m/sec
34	Gigahertz	GHz
35	Kilopounds Force	Klbf
36	Millimeters	mm
37	Degrees of Angle	deg
38	Day	day
39	Year	year
40	Millibars	millibar
41	Frames per Second	frames/second
42	Spectral Radiant Intensity	W/(sr nm)
43	Spectral Irradiance	W/(cm^2 nm)
44	Spectral Radiance	W/(sr cm^2 nm)
45	Grams per Cubic Meter	g/cubic meter
46	Parts per Million	parts/milion

21. AMSC Default SAF Parameters

Default values for common header parameters utilized by various AMSC analysis tools are listed below. These are supplied by the software if parameters are not included in the SAF file.

TAG	VALUE
BgType	FIX
BgValu	0.0
Class	Unclassified
Comprs	None
EURaw	RAW
FldFrm	2
FlorFr	FRAME
Frate	30
Intrlc	NO
Keywrd	IMG
LinLog	LIN
MagFacX	1.0
MagFacY	1.0
OffCor	0.0
PodOrd	Column
SclFac	1.0
TPFact	1.0

22. Special Function Applied to Images

The text value of the SpecFn tag is an algebraic expression which is to be applied to the image after all other processing is completed. Header values are referenced as $tag where 'tag' is the name of the desired header tag. Each pixel value is referenced as x. Thus a sample expression is

```
"1.01 + x + sin(x*pi) / ($TALO/2)^3".
```

23. Calculated Parameters

The analysis software will parse the text value of each CalcXX tag for the name, units, and the algebraic expression which defines this parameter. The parameter values will be calculated. Header values may be referenced by $tag where 'tag' is the name of the desired header value. The value of other parameters included in the file are referenced by placing the case sensitive name in single quotes. There may be up to 99 such parameters.

A sample text value is

```
"Mach Number", "", "'speed' * 1024.2 / $Temp^2"
```

24. Compression Type

In the past, AMSC software allowed for the gzip compression of image data within a data file. This was indicated by setting the value of ‘Comprs’ to ‘gzip’. AMSC software no longer supports creating compressed files, but will still read data that was archived in this manner. Therefore, the only value that should now be used for the Comprs tag is NONE.

25. Multiple Images or Parameter Groups

The presence of the Multi tag with a valid value indicates that there are multiple images or parameter groups in the file. A valid value is **NoHeaders**, which indicates that all images are of identical size with no header separating the images. The POD file specified by the tag ReFile will be used to obtain differences, such as TALO.

26. Include Headers

A header may include information from another standard header file. This additional header may contain information which is common to many files, for example. Or, it may contain information that would change the classification or processing of the data. Any information in an included header will override the values in the top level header. Included headers may reference yet other headers.

27. Additional Reference Information

The InFile tag specifies the name of an ascii file which has additional reference information. This information may be required by custom software when analyzing the data.

28. Pixel Widths

The pixel widths for images are expected to be in the default units of meters. Some images may have non-spatial dimensions, such as time or frequency. In these cases, the units of the dimensions should be specified in the XUnits and YUnits tags. For example, "YPxWid 0.08333" with "YUnits second" will set the y dimension to time in seconds, with an increment of 0.08333 seconds between scan lines.

29. Distribution Statements

- **A** -- Approved for public release; distribution is unlimited.
- **B** -- Distribution authorized to US Government agencies only.
- **C** -- Distribution authorized to US Government agencies and their contractors.
- **D** -- Distribution authorized to the DoD and DoD contractors only.
- **E** -- Distribution authorized to Dod Components only.
- **F** -- Further dissemination only as directed by controlling Dod office or higher DoD
- **NR** -- Not Releasable

30. Classifications

WNINTEL is not used anymore, but it may exist in archived data.

- Unclassified

?? Confidential

?? Secret

?? Secret - Formerly Restricted Data

?? Secret - Restricted Data

?? Secret - Restricted Data - CNWDI - WNINTEL

?? Secret - Foreign Government Info

?? Secret - US-UK Only

?? Secret - US-FR Only

?? Secret - NOFORN - Foreign Government Info

?? Secret - NOFORN - WNINTEL - Formerly Restricted Data

?? Secret - NOFORN - WNINTEL - Restricted Data

?? Secret - NOFORN - WNINTEL - Formerly Restricted Data-Restricted Data

?? Secret - NOFORN - WNINTEL - ORCON

?? Secret - NOFORN - CNWDI - WNINTEL - Restricted Data

?? Secret - NOFORN

?? Secret - COMSEC

?? Secret - LIMDIS - CIRCE

?? Secret - LIMDIS - LIMIT PLAY

?? Secret - LIMDIS

?? Top Secret

31. Elevation Angle Definition

Elevation angle is used in specifying the location of a target in relation to a sensor. Elevation angle is defined as the angle between the sensor-to-target line-of-sight vector and the horizontal plane centered on the sensor. The horizontal plane is that plane which is perpendicular to the normal from the sensor to the earth. The earth is modeled using a geodetic coordinate system based on some given reference ellipsoid, such as WGS-84. The ellipsoid used in the calculations is the one to which the original sensor and target location data were referenced. Elevation angles range from -90 degrees to +90 degrees, negative being below the plane.

32. Azimuth Definition

Azimuth is used as is elevation angle (See Note 31) in specifying the location of a target in relation to a sensor. Azimuth is defined as the angle between true north and the projection of the sensor-to-target line-of-sight vector onto the horizontal plane. Azimuth is measured clockwise from true north, ranging from 0 degrees to 360 degrees. True north is the direction of increasing geodetic latitude along the geodetic meridian intersecting the sensor. The geodetic meridian is specified by the sensor's geodetic longitude.